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Big Data Processing Model for Smart City Design: A Systematic Review

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ABSTRACT

Cities across the globe are considering transitioning into a smart city concept by implementing big data applications which help them in reaching the requisite level of sustainability and improving the standards of living of people. This paper reviews the applications of big data to smart cities by searching different databases using specific keywords and following a systematic data mining methodology for selecting the desired literature for further review. It identifies the appropriate definition of the smart city and big data and discusses the various opportunities, challenges and benefits of incorporating big data applications for smart cities.

Keywords: Smart cities, Big data, Systematic review, Applications program, Internet of Things

1. INTRODUCTION

Cities play a prime role in social and economic aspects worldwide, and have a huge impact on the environment (Mori & Christodoulou, 2012). In the urban planning field, the term "smart city" is often treated as an ideological dimension according to which being smarter entails strategic directions. Governments and public agencies at all levels are embracing the notion of smartness to distinguish their policies and programs for targeting sustainable development, economic growth, better quality of life for their citizens, and creating happiness (Ballas, 2013).

Big data has changed the game for most of the industries over the past few decades. (Shapiro, 2016) has predicted the revenues for worldwide big data market with respect to software and services to rise from $42B in 2016 to $103B in 2027 which means that it shall grow at a Compound Annual Growth Rate (CAGR) of 10.48%. The concept of big data has been linked to the information technology and has been defined as the volume of data which goes above the processing capacity of the current database and is difficult to be handled by traditional database techniques. It can be applied to architecture since it involves a large amount of data and needs different techniques, tools, methods for the purpose of solving new problems or the existing challenges in new ways (Vanolo, 2014). It has also been observed globally that governments are beginning to utilize big data for the purpose of supporting the development as well as sustainability of global smart cities. This move has helped the cities in maintaining their standards, ethics, and effective applications of big data in smart city by maintaining their inherent characteristics. The inherent characteristics of smart cities include sustainability, pliability, authority, improved quality of life, as well as proper management of natural resources and other facilities (Farazi, Maltese, Dutta, Ivanyukovich, & Rizzi, 2013). Application of big data in architecture can be done in components including transportation, governance, location, and public as well as its applications and services like education, healthcare, logistics and effective management of energy and facilitation of these applications and services require large computational and storage facilities to be set up. This study aims to create a synthesis of important works of literature in application of big data in smart city design.

2. BACKGROUND AND LITERATURE REVIEW

A. Context and State-of-the-Art for Smart Cities

The environment of cities is usually made up of input of goods as well as the output of waste including reliable negative externalities, which intensify social and economic troubles. It is evident that smart cities tend to rely extensively on external resources and therefore, are regarded as the biggest consumers of resources (Alwinkle & Cruickshank, 2011; Arribas-Bel, Kourtit, & Nijkamp, 2013). The concept of smart cities has become very popular in scientific literature as well as global policies and therefore, it is important to understand their key elements.

The term smart city was first used in the 1990s with increasing focus on significance of new ICT to modern infrastructure within cities. From the point of view of technology, a smart city is regarded as one where a lot of emphasis is given to application of ICT to critical infrastructure components as well as services (Thite, 2011). In case of smart cities, big data is used for the purpose of effective use of intelligent-acting products and services, employment of artificial intelligence, and other similar simulation machines (Klein & Kaefer, 2015). An example of systems equipped in smart cities include smart homes and smart buildings which have a number of mobile terminals and embedded devices including connected sensors and actuators (Ghaffarian Hoseini, Dahlan, Berardi, GhaffarianHoseini, & Makaremi, 2013). Therefore, in current times, globally cities are looking for solutions in order to facilitate transportation linkages, uses of mixed land and provision of high-quality urban services to have a positive impact on the economy just like having an efficient public transport affects to economic needs of the citizens and increases employment of labor which helps in driving growth of the city (Bakici, Almirall, & Wareham, 2012; Molinari, Maltese, Vaccari, Almi, & Bassi, 2015). A few of the novel approaches which are linked to urban services are based on harnessing technologies in order to create “smart cities.” The concept of the smart city goes beyond the application of technologies to cities as it can be applied in various different sectors and framing appropriate policies to make the cities “smart” (Shapiro, 2016).

B. Big Data: Meaning, Challenges, Application and Advantages

Big data can be defined as extremely huge data sets which need to be analyzed for the purpose of revealing trends, patterns and associated related to human interactions (Malik, 2013). According to (Bouwman, de Reuver, & Nikou, 2017), big data is catalogued and stored at different places which are owned by different organizations and it remains unused. Previous studies (Evans, 2015; Grolinger, Higashino, Tiwari, & Capretz, 2013; Taylor-Sakyi, 2016) have found that there are large number of potential uses of big data for providing solutions to various problems by using data from the source or analyzing it to obtain valuable insights by using through data analytics techniques such as data intelligence and data mining. In order to meet the growing demand for resources for the purpose of supporting big data analytics, the cloud has offered an extremely efficient solution by providing an appropriate platform for resources which requires a large number of resources for collaborating actively between different applications (Shrestha, 2018). This solution is the best fit to meet the requirements of smart city applications and helps in providing solution to a few of their challenges. By providing superior technology, smart cities have the probability of becoming smarter and achieving their goals more effectively (Bakici et al., 2012).

The main advantage of big data applications is its ability to help its users in making more informed decisions by being able to effectively handle and analyze large volumes of data in a short span of time. The analysis of big data includes information regarding web server logs, internet click stream data, social media content and activity reports, text from customer emails, mobile phone call details and machine data captured by multiple sensors (Skog, Wimelius, & Sandberg, 2018). Organizations from different domain are investing in big data applications, for examining large data sets to uncover all hidden patterns, unknown correlations, market trends, customer preferences and other useful business information (Kaur, 2013; Vijayrani & Sharmila, 2016).

C. Application of Big Data into Smart Cities

From the given definitions of smart cities and big data, it can be seen that smart cities provide an integrated living solution which helps in linking different aspects of life including power, transportation, and buildings in a neat and competent manner for the purpose of improving the quality of life for it citizens. Big data helps in the development of smart cities by providing platforms such as cloud computing which helps in the utilization of various benefits of using cloud services in supporting management of big data in smart cities (Brinkhues, Freitas Junior, & Marçada, 2015). Previous research studies done in this field have highlighted the importance of big data in sustaining smart city applications as well as services along with investigating the various issues of employment of big data in smart cities (Kenney & Zysman, 2016; Nuaimi, Neyadi, Mohamed, & Al-Jaroodi, 2015).

Big data is formed when it is generated from numerous sources including pervasive data sources like data from use of smart phones, laptops, environmental sensors, cameras, GPS and activities of people. Data generation has accelerated in recent years due to the increase usage of applications like social media, increased exchange of digital pictures and videos, advent of commercial transactions and proliferation of advertising applications and games (Paskaleva, 2011).

The usage of these smart city applications leads to generation of huge amounts of data and big data systems help in utilization of this data for the purpose of providing information to improve the performance of smart cities applications. The big data systems help in storage, processing, and mining of information received from smart cities applications in an effective manner for producing information to improve different smart city services (Kitchin, 2016). Additionally, big data also helps the decision-makers in making decisions including expansion in smart city services, resources, or areas.

3. METHODOLOGY

This study has used qualitative methods based on systematic review of secondary data. This section shall explain the process for selection of studies by using certain inclusion and exclusion criteria and keywords.

A. Search Strategy and Selection Process

The systematic review done in this study was conducted with the help of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) application. The study searched several studies for the purpose of gathering the requisite amount of information on the current topic. Therefore, a search strategy was formulated for the purpose of identifying the estimated number of studies which were already present in this context. There is use of different databases including Social Work Abstracts, Art & Architecture Source, Avery Index to Architectural Periodicals, Architectural Digest Magazine Archive, Art & Architecture Complete, OnArchitecture, eBook Collection (EBSCOhost), Frick Art Reference Library Periodicals Index and Humanities Abstracts. Additionally, Google Scholar database is also used in order to identify more studies in addition to the studies already identified. The rules provided by PRISMA along with use of different terminology related to architecture were taken into consideration while browsing through the EBSCOhost database.

B. Databases Searched List

Following databases are searched for the study.

i. Art & Architecture Source

ii. Avery Index to Architectural Periodicals

iii. Architectural Digest Magazine Archive

iv. Art & Architecture Complete

v. OnArchitecture
vi. eBook Collection (EBSCOhost)
vii. Frick Art Reference Library Periodicals Index
viii. Humanities Abstracts
ix. Social work Abstracts

C. Keywords

The study mainly studied those studies which included more than one keyword which were included in the eligibility criteria. A conduct of search showed that a total of 988 relevant studies appeared against the keywords as mentioned below.

i. Big Data
ii. Smart cities OR Design OR Framework
iii. Architecture
iv. Application of smart city
v. Application of big data
vi. Indicators
vii. Sustainability
viii. Urban development
ix. Social OR economic OR technological development

D. Inclusion Criteria

The studies were included using the following criteria:

- Studies which provided full access.
- Studies which included complete information on the topic.
- Studies which were available in English language.
- Studies which included more than one relevant keyword to the literature.
- Studies published in the last 10 years only in order to include current information and avoid considering studies with obsolete findings.

- Studies which focused on the application of big data application to smart cities including their benefits, limitations and suggestions to overcome these limitations including journal articles, research papers and commercial reports.

E. Exclusion criteria

There were a few eligibility criteria formulated for the purpose of including only the relevant studies and excluding the studies which did not match the aims and objectives of the current study. The studies matching the following exclusion criteria were excluded:

- Studies which granted restricted or no access for reading or only allowed abstracts to be viewed.
- Studies which provided only limited information with respect to the current subject.
- Studies that were published only in languages other than English.
- Studies which were published before 2000 in order to avoid consideration of obsolete information.
- Studies which proposed the use of new models, software or other commercial tools.
- Studies which concentrated only the benefits of big data application and did not investigate the challenges and limitations.

F. Study Selection

Using the different databases, a total of 988 studies are identified. The uses of criteria led to removal of 211 duplicate studies as they included irrelevant and repeated data. Therefore, a total of 777 studies were available for screening and eligibility. After this step, there was excluded the studies with limited access and information along with screening of abstract. This process led to the removal of 332 more studies after which 388 studies were removed because of improper cognitive representation and limited access. Out of the 31 studies that were excluded after the full text screening process, sixteen studies met the inclusion criteria.

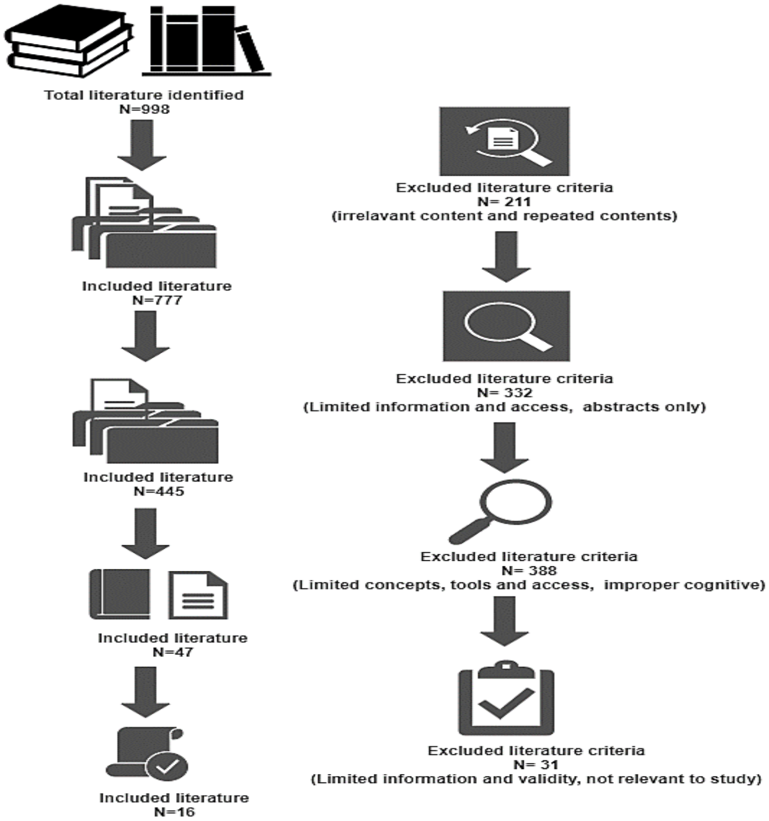
Total literature identified
N=998
Excluded literature criteria
N= 211
(irrelavant content and repeated contents)
Included literature
N=777
Excluded literature criteria
N= 332
(Limited information and access, abstracts only)
Included literature
N=445
Excluded literature criteria
N= 388
(Limited concepts, tools and access, improper cognitive)
Included literature
N=47
Excluded literature criteria
N= 31
(Limited information and validity, not relevant to study)
Included literature
N=16

Figure 1: Overview of the PRISMA framework to Select the Literature Review

G. Data Extraction

The first step includes gathering the available data and listed the basic information for each of the study including its method, sample size, name and number of authors, date of publication, demographic details, location and the method of analysis.

- **Study design:** for the studies reviewed, over half of the studies (n = 8) were meta-analysis studies, n=4 were case studies and the rest were qualitative studies based on secondary data (n=4). Most of the studies were conducted in Europe and America and others were conducted in Libya, India, Taiwan, Saudi Arabia and China.
- **Study sample:** The studies included secondary data obtained from journals, books, periodicals, reports and other published information. The number of studies which were reviewed in these studies ranged between 20 and 50.

4. RESULTS AND DISCUSSION

This section summarizes the findings of the selected studies by discussing the benefits as well as challenges of application of big data in smart cities. In the end, concluding remarks have been made along with identifying the missing element in the research studies.

(Long, 2019) found that smart cities make use of information and communication technology for the purpose of sensing, analyzing and integrating the main information of the main system of operation for making them respond to their different needs by doing a systematic review of 15 studies. Smart cities help in changing the social and economic lifestyle along with promoting new views of people regarding physical as well as cognitive space and ability. It has been observed that though smart cities offer convenience but leads to a lot of obstacles. This study has examined the features of smart city as well as the present situation of its operation and helps on designing the road map of development of smart city by drawing on the experience of construction of smart cities.

(Bibri & Krogstir, 2018) found that processing of information is embedded in the systems and helps the cities in enhancing its functioning and designs. The objective of this study is to understand the main technological components of big data for the purpose of demonstrating the opportunities and applications computing have to offer along with identifying the challenges faced by smart sustainable cities. The study employed a systematic review method to do a meta-analysis of 25 studies in this paper. It has been argued that for the purpose of urban sustainability, big data analytics and context–aware computing need to be leveraged. The study found that it is important to reinforce both for encouraging their efforts of reforming urban life by employing the big data tools to enhance, harness, as well as integrate urban systems to encourage collaboration in urban domains.

(Patil & Nadaf, 2017) found that administration of cities is difficult as it involves a lot of functions and organizations. This study identified and analyzed new methods and concepts which could be applied in the daily activities of the smart city along with discussing the various devices which are involved in the smart city and integration of data management center. For this purpose, the author has done a comparative analysis of smart cities with normal cities by collecting data from 18 studies and analyzed the effectiveness of various applications using case studies.

(Navarro, Tomas-Gabarron, & Escolano, 2016) in their study assessed the network of acoustic sensors for the purpose of monitoring the level of sound in cities. This study has investigated the applicability of the various methods of big data for environmental betterment by doing a systematic review of 22 studies. This paper has provided the potential applications of big data for the purpose of monitoring noise in smart cities. Moreover, a preliminary study has been presented with data collected from a real smart city in order to evaluate the sound pressure level of sensors in different time intervals.

(Nuaimi et al., 2015) in their study found that big data analytics has a big potential for enhancing services in smart cities. This paper has evaluated 16 studies related to the application of big data to smart cities by discussing various definitions of the smart city and big data along with exploring the opportunities, limitations and advantages of applying big data in smart cities. It has also attempted to identify the requirements that support the implementation of big data applications for smart city services. The study has identified various opportunities which are untapped for the utilization of big data in smart cities; but various bottlenecks still need to be addressed for ensuring optimum utilization of this technology.

(Hafezz, 2017) reviewed the impact of big data on the smart city by identifying the benefits, challenges along with the relationship of big data with internet of things, selected smart city platforms and framework by doing a comparative analysis of 20 studies conducted in Arab Nations. The study evaluated the idea of introduction of big data applications in Arab Nation and it was found that big data analytics are beneficial for smart cities by improving the quality of life despite the various challenges faced.

(MAheshwari, 2018) in his study has discussed smart services framework along with the ten types of smart services. It has followed case study methodology and obtained information from 15 studies conducted on successful smart city transitions by analyzing Barcelona and Amsterdam, along with the methods employed by them to become smarter. They analyzed a bike rental service in Chicago to study the effective use of big data in various companies. Also, the social aspect of the use of big data was studied in order to address the need for sensitivity to human needs and privacy.

(Lim, Kim, & Maglio, 2018) reported findings by analyzing cases of big data in global cities and the four projects of the author with government organizations toward developing smart cities and enhance urban planning and development of policies in the modern economy. This study has used multi-case analysis method and action research method by analyzing 20 cases of big data use in smart cities and classified the urban data use cases into four reference models and found that there were six main challenges faced in applying big data in smart cities. Furthermore, this study has proposed five considerations in order to address the obstacles faced in implementing these models in real world.

(Alshawish, Alfagih, & Musbah, 2016) found that the huge volume, velocity as well as variety of data generated in smart cities necessitates the application of “Big Data” technologies for deriving important insights from it. This study has reviewed the current application as well as the potential areas of application of Big Data technology in order to transform a city to be smart by doing a systematic review of 30 studies conducted on the transition of smart cities. It found that the smartness of the city driven by data can be achieved by transforming the data adequately for the purpose of improving the system application of a city by including a few real world examples depicting the applications of Big Data in Smart Cities with respect to utilization of energy, public safety and traffic systems.

(Wu, Chen, Wu, & Lytras, 2017) have discussed the concept of a smart city developed on the foundation of information and communication technology (ICT) along with analyzing the aims of development of smart city in Taiwan by doing a systematic review of 33 studies. The study has also evaluated the supporting technologies in order to assist the development by proposing a hierarchical structure of systems of smart cities by using five dimensions, namely, the Internet of Things (IoT), cloud computing, Big Data, Mobile Network, and smart business. The city has proposed a Big Data platform which employs information from ubiquitous sensor networks for analyzing the Big Data application process of smart cities and identifies the various benefits and challenges.

(Hashem et al., 2013) have described the current communication as well as smart-based applications employed in the smart cities by doing a systematic review of 40 existing studies. The utilization of big data analytics for support smart cities has been discussed by understanding the impact of big data on urban populations at various levels. Also, they have proposed a future business model for managing big data for smart cities along with identifying the business and technological research challenges.

(Shrestha, 2018) believed smartness of a city is fueled by information which is obtained from data on topics including transportation, healthcare, government, power grids by reviewing studies from 24 cities. It was found that information obtained from these sources would gradually transform into massive information that is autonomous, heterogeneous as well as evenly distributed which is known as big data. This study has mentioned that practical big data applications tend to roll out helpful information from this massive data.

(Molinari et al., 2015) in their paper have offered the perspectives along with obstacles faced in submission of Big Data in a Smart City by employing case study methodology and selected the case of Trento, Italy. It reviewed 10 studies on the topic and finally found that the obstacles faced by application of Big Data applications are cultural, governance, technological and company enablers.

(Albino, Berardi, & Dangelico, 2015) have aimed to elucidate the meaning of smart cities in the context of cities by studying 25 relevant studies by identifying the chief features of a smart city. The different metrics of smart cities have been identified as providing a common definition of meaning of a smart city, its features, as well as its performance with respect to other cities along with analyzing their performance as well as initiatives in a few smart cities.

(Kitchin, 2016) in his study has examined the types, practices and morals of smart cities and urban science by emphasizing on rationality of instrument, realist epistemology; privacy, datafication, dataveillance and geo surveillance; and data uses, such as social sorting and anticipatory governance. It performed a meta-analysis of 27 studies and found that smart city initiatives and urban science need to be re-cast in three ways: a re-orientation in how cities are conceived; a reconfiguring of the underlying epistemology to openly recognize the contingent and relational nature of urban systems, processes and science; and the adoption of ethical principles designed to realize benefits of smart cities and urban science while reducing pernicious effects.

(Soomro, Bhutta, Khan, & Tahir, 2019) found that the role of ICT has been growing in supporting smart cities along with the demand for big data analytics solutions. This study has done a systematic review of 14 of the existing studies on application of big data analytics to smart cities. A classification model was presented to determine the four aspects of research in this domain including data and computing models, security and privacy aspects. Also, a gap analysis was conducted in order to identify future directions for research.

Therefore, a systematic review of the above-mentioned studies shows that the benefits of application of big data applications to smart cities outweigh its limitations. However, no study has studied the benefits and advantages of individual big data applications in order to decide which ones to follow and which ones can be avoided. An analysis of the previous research studies conducted on this topic has led to the development of the most feasible model for big data processing in smart cities which has been depicted in figure 2. The figure shows that huge amounts of data is collected in smart cities from different sectors like transportation, healthcare, power grid, smart home and others. The data thus generated is collected and communicated using Wi-Fi, Ethernet and other means of internet. The data collected is stored and analyzed in an efficient manner for the purpose of producing relevant information used for enhancing different smart city services and preparation of a smart city plan. The main users of the information have been identified as government, citizens and security organizations.

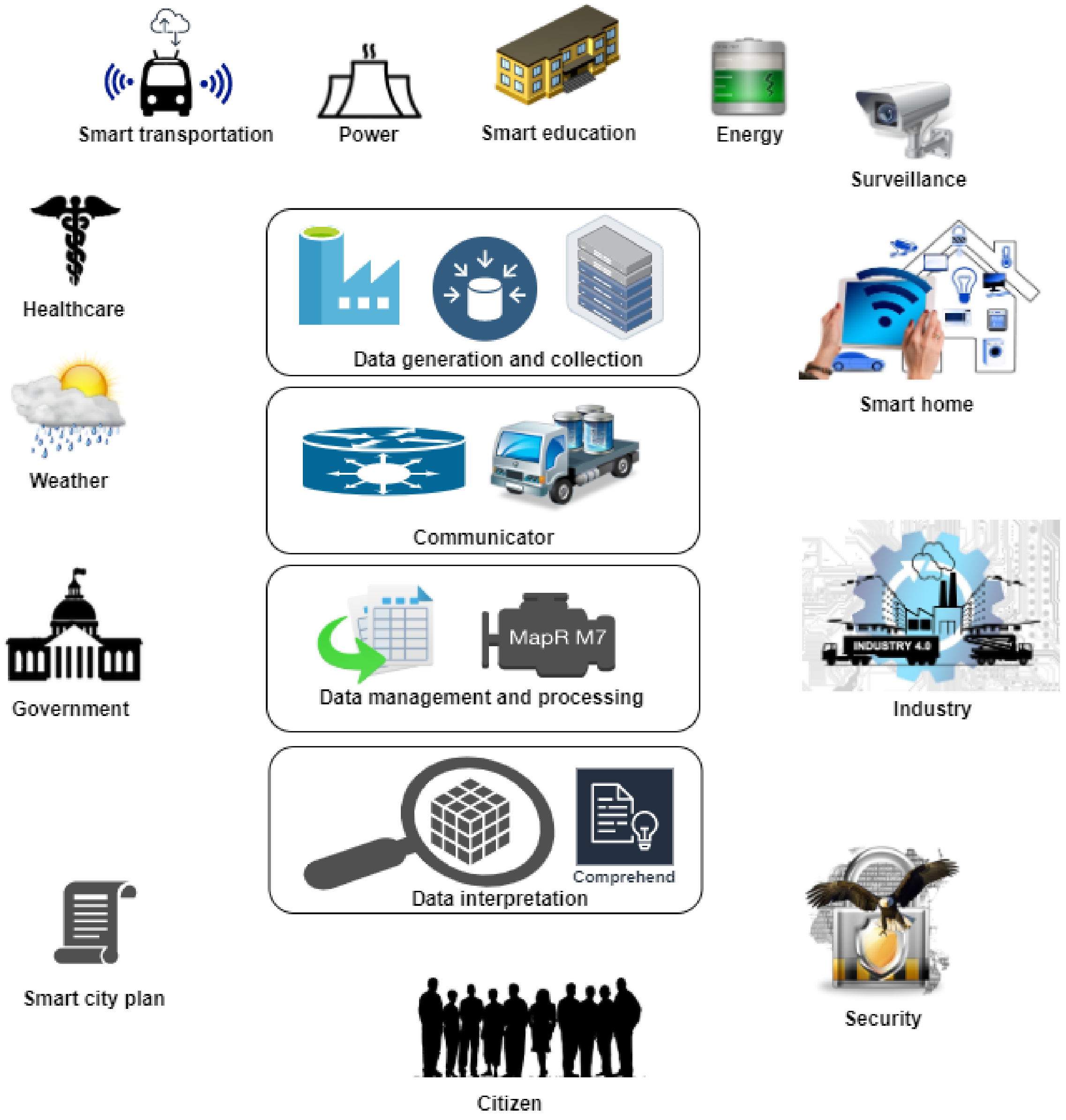

Figure 2: Big data processing model

5. CONCLUSION OF THE STUDY

With the rise in connected devices in smart cities has inevitably resulted in the increased generation of data which has been the topic of different researches in different research fields. This study aims to provide a complete outlook of the task of big data in smart cities and can serve as a benchmark for researchers and practitioners for the future progress and development of smart cities in the context of big data. The main objective of big data has been seen to extract important information from eternally growing volume of digital data which plays a vital job with respect to gaining important information for the purpose of making decisions. However, it has been observed that the research on big data in smart cities is still in infancy stage and there are various challenges which still need to be addressed in order to make it economically feasible.

There is ample scope for future work including development of a prototype model of a system using big data applications which can be applied in transition of cities to smart cities and evaluate its effectiveness. Also, the future research studies can further investigate the impediments that are incurred in the deployment of big data in smart cities. Also, there needs to be further studies conducted in order to investigate the best practices of designing a data-driven city by learning from the experience of existing smart cities including Masdar, Barcelona and Rio de Janeiro amongst others.

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39. APPENDIX

Name of Study	Key Findings	Number of Studies Reviewed
(Long, 2019)	The study found that with urbanization, Big data which can be represented by sensing technology, smart mobile devices, communication network and cloud computing technologies have been widely used in the construction of smart cities in affecting the livelihood of people, protection of environment, public safety, urban services as well as business activities.	Systematic review of 15 studies.
(Bibri & Krogstir, 2018)	Big data analytics have been transforming cities into smart cities by using technologies like pervasive sensing devices, computing infrastructures, data processing platforms, and wireless communication networks. It has been further promoted by digital transition in ICT which leads to an integration of different types of pervasive computing	Meta-analysis of 25 studies.
(Patil & Nadaf, 2017)	The study found that it was important for smart cities to optimally manage its resources without compromising the needs of its citizens and maintaining healthy environment. It also found that it was required for cities to be smarter in order to overcome the new challenges due to rapid changing of environment.	Comparative critical analysis of 18 studies.
(Nuaimi et al., 2015)	It was found that smart cities make use of different technologies for improving its services including health, transportation, energy, education, and water services by reducing costs and	Literature survey of 16 studies.

	consumption of resources for effectively and actively engaging with their citizens. Due to digitization, it has become easier to collect huge amount of data to be used optimally in different domains for smart cities.	
(Hafezz, 2017)	The study found that big data played a significant role in the development of smart cities as it provided valuable insights from huge amount of data which is collected through various sources. This utilization of big data helps the urban decision makers in providing better services to its citizens.	Comparative analysis of 20 studies.
(Maheshwari, 2018)	It was found that a city can be made smarter by improving the efficiency and responsiveness of its main infrastructure sectors like health, education, transportation, utilities, and other amenities by employing integrated design and electronic governance by applying information and communications technologies. They can also improve by fostering environments to flourish in thereby attracting more smart engaged citizens.	Case study methodology on 15 companies.
(Lim et al., 2018)	It was found that globally, cities are trying to transition themselves into smart cities and a systematic review of previous studies showed that the main factor in this transformation can be identified as the use of urban big data by stakeholders and other objects in cities. However, the facts and structure for use of data in these smart cities remained unidentified.	Multi-case analysis and action research on 20 companies.
(Alshawish et al., 2016)	The study refers to smart cites as technologically advanced cities which are competent enough to comprehend its environment by analyzing its data in a way to enable it to quickly solve its issues and to advance the quality of lives for its residents. The study investigated the visibility of the city, which refers to collection of data from its different networks, devices as well as sensors which are entrenched in its infrastructure along with the transformation of data to information by passing different processing stages, and by application of advanced analyzing Big Data platforms on data.	Systematic review of 30 studies.
(Wu et al., 2017)	This study analyzed the present state of development of smart cities in Taiwan. An analysis of the case study led to the proposal of a new philosophy related to development of smart city along with provision of a practical blueprint for the creation, operation, along with development of the smart cities with the objective of improving the future for Taiwan.	Systematic review of 33 studies.
(Hashem et al., 2013)	It was found that big data had the potential to provide cities with important information from the huge volume of data which was collected from different sources, and the Internet of Things helped in the integration of sensors, identification of	Systematic review of 40 studies.

	radiofrequency and Bluetooth in real time with the employment of highly networked services. The study found that the application of big data in smart cities has not been explored much as it brings new and interesting challenges for the development of future smart cities. These challenges were identified as being related to business and technology which has helped the cities in actualizing the vision, principles, as well as requirements of the applications of smart cities.	
(Molinari et al., 2015)	The study started by showing the current state of application of Big Data and Open Data in the city of Trento and continued to propose a line of development for the two which had a positive impact on the daily lives of its citizens. The study has given emphasis on the results which were observed from the discussion done during the meeting of working group meeting where the topic was discussed.	Case study methodology of 10 companies.
(Albino et al., 2015)	The study sought to properly define the term smart city as it was found that the popularity of the term “smart city” was gaining but there was still confusion regarding the concept of smart city.	Literature review of 25 studies.
(Kitchin, 2016)	The study found that operational governance and city services were becoming highly becoming driven by data as being the key mode of production for smart cities. This led to the city systems to reduce urban life to logic, instrumental sagacity and pragmatist epistemology.	Meta-analysis of 27 studies.
(Soomro et al., 2019)	The study found that artificial intelligence, data mining, machine learning and other solutions based on statistical analysis had been applied in thematic domains including climate science, energy management, transport, air quality management and weather pattern analysis. The thematic analysis identified the themes as smart city governance, economy, environment, transport and energy.	Systematic review of 14 studies.